PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
F04B 1/20 // F03C 1/06, F01B 3/00

A1

(11) International Publication Number: **WO 99/15790**

(43) International Publication Date: 1 April 1999 (01.04.99)

(21) International Application Number: PCT/FI98/00743

(22) International Filing Date: 23 September 1998 (23.09.98)

(30) Priority Data:
973764 23 September 1997 (23.09.97) FI

(71) Applicant *(for all designated States except US)*: RAUNISTO, Airi [FI/FI]; Anttilankatu 13, FIN–13210 Hämeenlinna (FI).

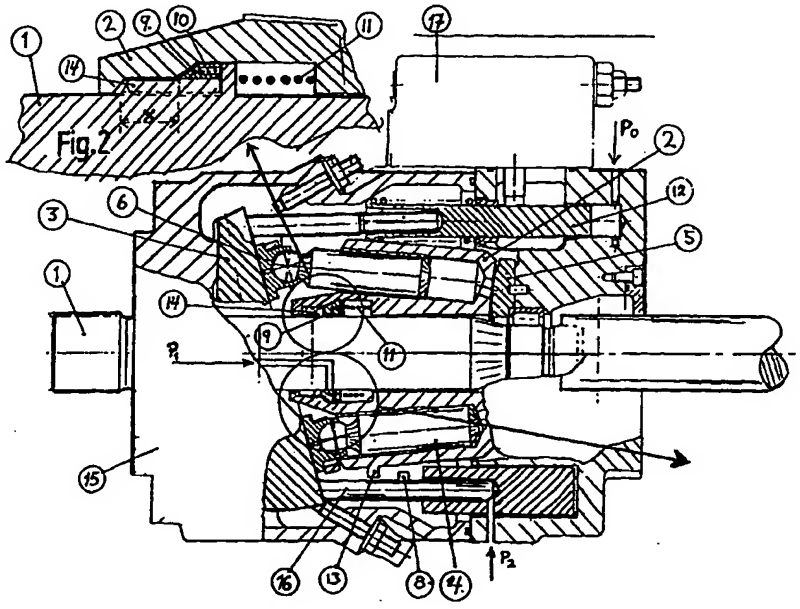
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: RAUNISTO, Yrjö [FI/FI]; Anttilankatu 13, FIN–13210 Hämeenlinna (FI).

(74) Agent: NIEMINEN, Taisto; Patenttitoimisto T Nieminen Oy, Kehräsaari B, FIN–33200 Tampere (FI).

(81) Designated States: JP, KR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
In English translation (filed in Finnish).

(54) Title: HYDRAULIC PUMP



(57) Abstract

A hydraulic pump comprising a mantle as pump body, a drive (1) shaft directed into the pump, a cylinder block (2) arranged around the shaft and rotated by said shaft, for instance by means of a longitudinal groove assembly (14), when the cylinder block is movable lengthways on said shaft. The length of the moment–transmitting groove assembly (14) placed between shaft (1) and cylinder block (2) is restricted axially so that the moment–transmitting capacity of the assembly can be released in shifting the cylinder block (2) axially till the cylinder block groove assembly becomes disengaged from shaft (1) groove assembly (14).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

HYDRAULIC PUMP

The invention relates to a hydraulic deplacement pump, where a cylinder block producing hydraulic flow and hydraulic pressure is rotated against the valve plate by a drive shaft. The length of piston strokes is adjusted by means of an oblique plate in the pump.

In known pumps the deplacement is adjusted by tilting the oblique plate. The deplacement is zero with the plate at 0° angle, i.e. exactly upright. When the pump rotates without load with the oblique plate perpendicular, the rotation power taken by the pump/motor may amount to 4-8% of the maximum deplacement. Therefore, it can be assumed that the rotation of the pump in itself will decrease the unit efficiency by 4 - 8 %.

There is friction, even by idling, among the mobile parts in the pump and furthermore, due to lubrication, the cylinder block rotates partly in the oil. Mobile parts are the slide paws of the pistons gliding on the oblique plate surface, likewise the cylinder block rotating against the valve plate. These circumstances mean power consumption even by idling.

By means of a hydraulic pump according to this invention the loss of power caused during idling can be decisively lessened and the invention is characterized in what is presented in the patent claims.

The advantage of this invention is that the rotation of the hydraulic block can be stopped by means of a special coupling construction, when no deplacement required from the pump. When deplacement required, the pump is put into rotating by means of the same coupling. The coupling can be built on the pump shaft, its actuators and on and off functions can be made to work automatically. In order to facilitate engagement, a synchronous ring can be used in order to facilitate the engagement of the

toothed coupling.

In the following the invention is disclosed with reference to the attached drawing, where

Fig. 1 is a cross-section of the hydraulic pump.
Fig. 2 is one embodiment of the coupling.
Fig. 3 is another embodiment of the coupling.

Figure 1 shows a hydraulic pump comprising, a mantle 15 as pump body, a drive shaft 1, a cylinder block 2 arranged around the shaft and rotated by said shaft by means of a longitudinal groove assembly 14, when the cylinder block is movable lengthways on said shaft, a not rotating valve plate 5 to convey oil to and from cylinder block 2, a not rotating oblique plate 3 that can be inclined for deplacement, pistons 4 moving in regard to the cylinder block cylinders and slide paws 6 in the piston ends sliding on the oblique plate surface. There is between shaft 1 and the cylinder block a moment-transmitting groove assembly 14. On the shaft surface there are longitudinal bulging strips and corresponding bulging strips on the surface of the cylinder block inner cylinder. The grooves run between the strips. The length of the longitudinal groove assembly is restricted so that the moment-transmitting capacity of the assembly can be released in shifting the cylinder group axially till the cylinder group groove assembly is disengaged from the shaft groove assembly 14. So the groove contact ceases to exist when the cylinder block is shifted to the left (fig. 1,2,3) as much as needed. The cylinder group is then disengaged and does not rotate along with its shaft.

It can be the question of such a situation when no deplacement needed. Disengagement can be done, for instance, mechanically as per figures 1 and 2 in adding to the oblique plate adjuster rod 16 a protruding part 8, which begins to move cylinder block 2 to

the left on hitting protruding part 13 in cylinder block 2. When oblique plate 3 is adjusted by means of rod 16 in shifting it to 0° angle or over it, the cylinder block 2 has travelled on shaft 1 so much that it has become is released from the groove assembly. In this manner an idling state with hardly any loss is achieved. Rod 16 is moved hydraulically by means of pressure P2 in association with pressure PO that moves rod 12. The pressures are controlled by means of a servo-valve known as such, whereat the oblique plate can be accurately held in any intermediate position. In addition, on the mantle outside there is a box for control valves.

Figure 2 is an enlarged representation of the groove assembly, showing that for disengagement the cylinder block must move a distance x to the left. For re-engagement the assembly has a synchronous ring 9, known as such, including spring 9. At first, the synchronous ring 9 that rotates along with shaft 1 touches the counter-face of the cylinder block,equalizes the speeds of rotation, whereupon the cylinder block can move to the right, engagement can take place and, finally, the position as per figure 2 is reached, where the synchronous ring is pressed against its spring and the groove assembly fully engaged. Spring 11 provides that cylinder block 2 starts to move from its free position to the right in order to become engaged when the coupling open-holding-power is released.

Figure 3 shows how the cylinder block 2 motion to the left to the coupling free position is realised by means of hydraulic pressure in conveying pressure groove assembly 14. The annular groove assembly is furnished with packings and formed as a cylinder that due to pressure conveyed into it expands moving cylinder block 2 to the left. After travel x the engagement is off. When the oblique plate has reached or slightly exceeded position 0°, pressure is conveyed to the groove assembly, when disengagement is wanted to take place.

By means of the invention disengagement of the cylinder block takes place automatically as a result of the oblique plate control. It is possible to fit small-sized toothed couplinges into the space available. Targets of use are several motor vehicle applications, where continuous deplacement is not required.

PATENT CLAIMS

1. A hydraulic pump comprising a mantle as pump body, a drive shaft (1) directed into the pump, a cylinder block (2) arranged around shaft (1) and rotated by said shaft, for instance by means of a longitudinal groove assembly (14), when the cylinder block is movable lengthways on the said shaft, a not rotating valve plate (5) to convey oil to and from cylinder block (2) and a not rotating oblique plate (3) that can be inclined for deplacement, pistons (4) including slide paws (6) in the piston ends sliding on the oblique plate surface, c h a r a c t e r i z e d in that the length of the moment-transmitting groove assembly (14) placed between shaft (1) and cylinder block (2) is restricted axially so that the moment-transmitting capacity of the assembly can be released in moving cylinder block (2) axially till the cylinder block groove assembly is disengaged from shaft (1) groove assembly (14).

A hydraulic pump according to patent claim 1 c h a r a c t e r i z e d in that, for shifting the cylinder block to free position, an element (8) is added to the oblique plate (3) adjuster to push the cylinder block lengthways as much as needed, while the adjuster moving.

3. A hydraulic pump according to patent claim 1 c h a r a c t e r i z e d in that, for shifting the cylinder block to free position, the hydraulic pump has a pressure oil channel to convey oil to the groove assembly, formed as cylinder space between shaft (1) and the cylinder block which is expanded by oil entering it, thus moving the cylinder block lengthways as much as needed.

4. A hydraulic pump according to any of the above patent claims 1-3 c h a r a c t e r i z e d in that, for reversing the cylinder block to on-position, a spring (11) is connected to the

cylinder block in order to push the cylinder block against valve plate (5).

5. A hydraulic pump according to any of the above patent claims 1-4 c h a r a c t e r i z e d in that, for securing engagement, there is in association with the groove assembly a synchronous ring (9) and a spring (10) to shift the ring on the shaft (1).

6. A hydraulic pump according to any of the above patent claims 1-5 c h a r a c t e r i z e d in that the engagement arranged by the groove assembly is released when the oblique plate (3) reaches the 0° angle or when the oblique plate has exceeded the 0° angle.

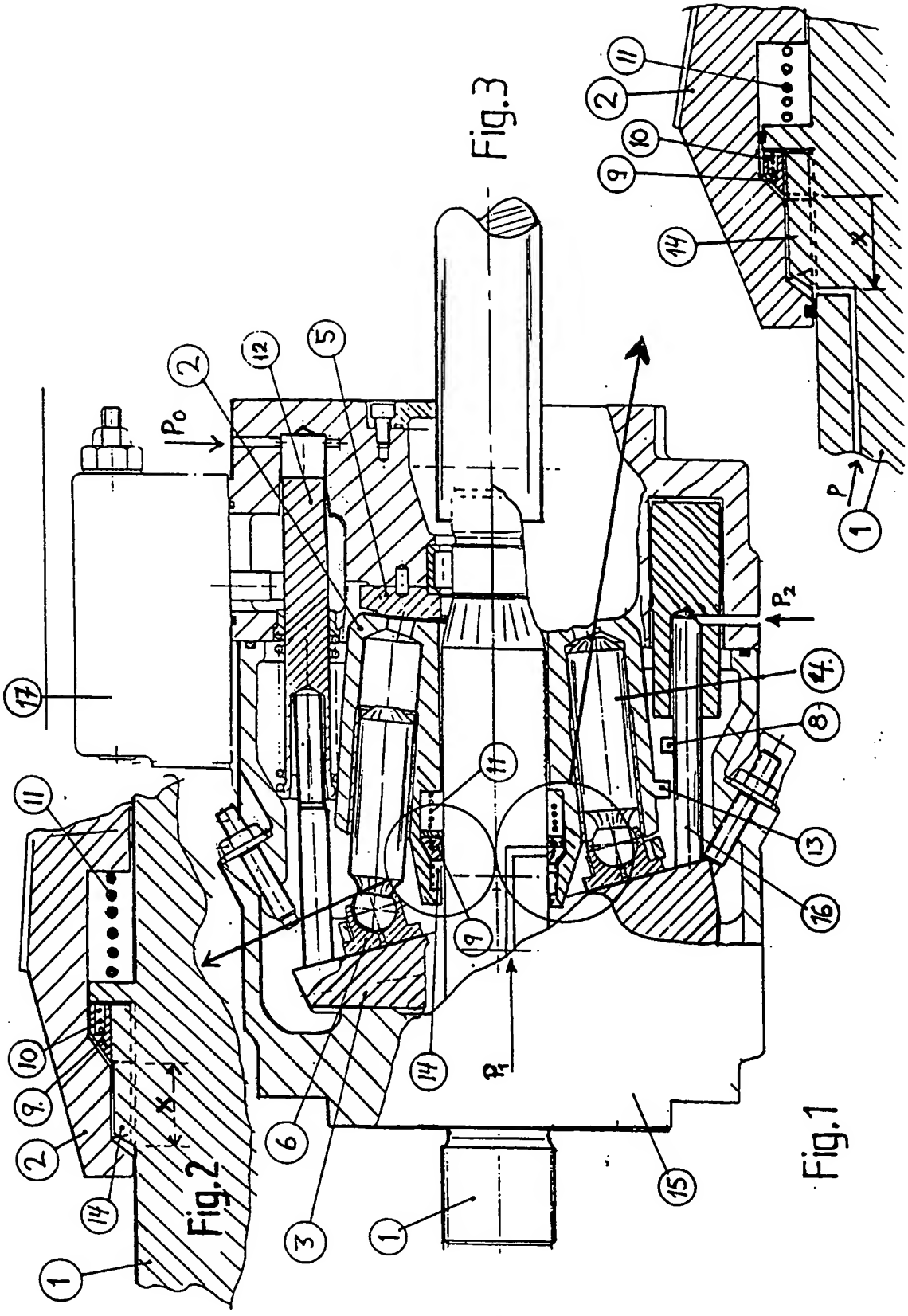


Fig.3
Fig.2
Fig.1
P0
P1
P2
P
X
BEST AVAILABLE COPY

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00743

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F04B 1/20 // F03C 1/06, F01B 3/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F01B, F03C, F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EDOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4579043 A (NIKOLAUS ET AL), 1 April 1986 (01.04.86) --	1
Y	US 3643433 A (WIDMAIER), 22 February 1972 (22.02.72) --	1
Y	WO 9304281 A1 (BRUENINGHAUS HYDRAULIK GMBH), 4 March 1993 (04.03.93) --	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 December 1998	16 -12- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Sune Söderling Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/12/98

International application No.
PCT/FI 98/00743

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4579043 A	01/04/86	DE 3338747 A,C	09/05/85
		JP 60111066 A	17/06/85
US 3643433 A	22/02/72	CH 510216 A	15/07/71
		DE 1924010 A	19/11/70
		FR 2046559 A	05/03/71
		GB 1312275 A	04/04/73
WO 9304281 A1	04/03/93	AT 129781 T	15/11/95
		AU 669119 B	30/05/96
		AU 2326692 A	16/03/93
		BR 9206394 A	14/11/95
		DE 4127817 C	28/01/93
		DE 59204207 D	00/00/00
		EP 0599870 A,B	08/06/94
		SE 0599870 T3	
		FI 940827 A	22/02/94
		JP 6510352 T	17/11/94
		NO 302631 B	30/03/98
		NO 940594 A	21/02/94
		RU 2091609 C	27/09/97
		US 5431245 A	11/07/95